

TO : Genera

DATE : Mar. 24. 2004

SAMSUNG TFT-LCD**MODEL NO.:LTN150PG-L03**Any Modification of Spec is not allowed without SEC' permission

APPROVED BY :

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SAMSUNG ELECTRONICS CO., LTD.**Samsung Secret**

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REVISION HISTORY

Preliminary

Date	Rev.No.	Page	Summary
Mar. 24, 2004	000	All	LTN150PG-L03 model rev.000 specification was First issued.
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GENERAL DESCRIPTION

DESCRIPTION

LTN150PG-L01 is a color active matrix TFT (Thin Film Transistor) liquid crystal display (LCD) that uses amorphous silicon TFT as a switching devices. This model is composed of a TFT LCD panel, a driver circuit and a backlight system. The resolution of a 15.0" contains 1400 x 1050 pixels and can display up to 262,144 colors. 6 O'clock direction is the Optimum viewing angle.

FEATURES

- Thin and light weight
- High contrast ratio
- SXGA-Plus (1400x1050 pixels) resolution
- Low power consumption
- DE (Data enable) only mode.
- LVDS Interface with 2 pixel / clock (2 channel)

APPLICATIONS

- Notebook PC
- If the usage of this product is not for PC application, but for others, please contact SEC

GENERAL INFORMATION

ITEM	SPECIFICATION	UNIT	NOTE
Display area	304.1(H)X228.1(V) (15.0"diagonal)	mm	
Driver element	a-si TFT active matrix		
Display colors	262,144		
Number of pixel	1400 x 1050 (SXGA-Plus)	pixel	
Pixel arrangement	RGB vertical stripe		
Pixel pitch	0.2175(H) x 0.2175(V)	mm	
Display Mode	Normally white		
Surface treatment	HAZE 25, HARD-COATING 3H		

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Mechanical Information

ITEM		MIN.	TYP.	MAX.	NOTE
Module Size	Horizontal (H)	316.8	317.3	317.8	
	Vertical (V)	241.6	242.1	242.6	
	Depth (D)	-	-	6.0	
Weight			550g	565g	

Note (1) Depth of signal interface connector part.

1. ABSOLUTE MAXIMUM RATINGS

1.1 ENVIRONMENTAL ABSOLUTE RATINGS

ITEM	SYMBOL	MIN.	MAX.	UNIT	NOTE
Storage temperate	T_{STG}	-20	60	°C	(1)
Operating temperate (Temperature of glass surface)	T_{OPR}	0	50	°C	(1)
Shock (non-operating)	S_{nop}	-	240	G	(2), (4)
Vibration (non-operating)	V_{nop}	-	2.41	G	(3), (4)

Note (1) Temperature and relative humidity range are shown in the figure below.

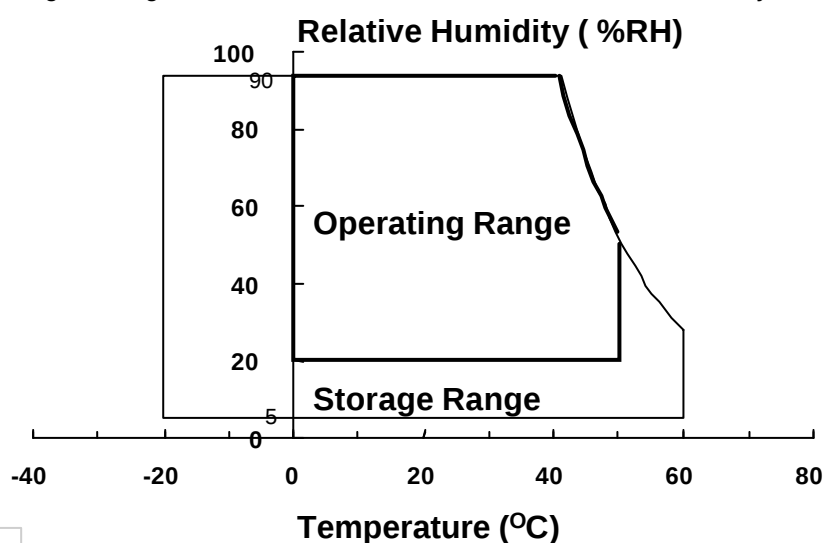
95 % RH Max. ($40^{\circ}\text{C} \geq T_a$)

Maximum wet - bulb temperature at 39°C or less. ($T_a > 40^{\circ}\text{C}$) No condensation.

(2) 2ms, half sine wave, one time for $\pm X, \pm Y, \pm Z$.

(3) 10 300 10 Hz, Sweep rate 10 min, 30 min for X,Y,Z.

(4) At testing Vibration and Shock, the fixture in holding the Module to be tested have to be hard and rigid enough so that the Module would not be twisted or bent by the fixture.



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1.2 ELECTRICAL ABSOLUTE RATINGS

(1) TFT LCD MODULE

 $V_{DD} = 3.3V$, $V_{SS} = GND = 0V$

Item	Symbol	Min.	Max.	Unit	Note
Power Supply Voltage	V_{DD}	$V_{SS} - 0.3$	3.6	V	(1)

Note (1) Within T_a ($25 \pm 2^\circ C$)

(2) BACK-LIGHT UNIT

 $T_a = 25 \pm 2^\circ C$

Item	Symbol	Min.	Max.	Unit	Note
Lamp Current	I_L	3.0	7.0	mArms	(1)
Lamp frequency	F_L	40	80	kHz	(1)

2. OPTICAL CHARACTERISTICS

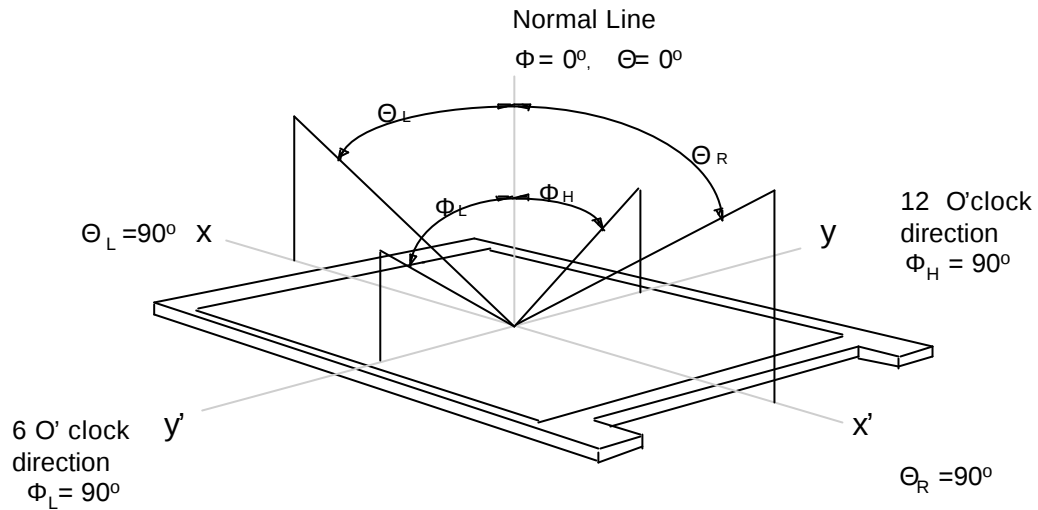
The following items are measured under stable conditions. The optical characteristics should be measured in a dark room or equivalent state with the methods shown in Note (5).
Measuring equipment : TOPCON BM-5A and PR-650

* Ta = 25 ± 2 , VDD=3.3V, fv= 60Hz, fdCLK=54MHz, IL = 6.3 mA

ITEM		SYMBOL	CONDITION	MIN.	TYP.	MAX.	UNIT	NOTE
Contrast Ratio (5 Points)		CR	Φ= 0, Θ= 0 Normal Viewing Angle	300	-	-		
Response Time at 25	Rising	T _R		-	10	15	msec	(1), (3)
	Falling	T _F		-	15	20		
Luminance of White		Y _L		180	200	-	cd/m ²	(1), (4) @6.3mm
Color Chromaticity (CIE)	Red	R _X		0.560	0.580	0.600		(1), (5) PR650
		R _Y		0.320	0.340	0.360		
	Green	G _X		0.290	0.310	0.330		
		G _Y		0.530	0.550	0.570		
	Blue	B _X		0.135	0.155	0.175		
		B _Y		0.135	0.155	0.175		
	White	W _X		0.293	0.313	0.333		
		W _Y		0.309	0.329	0.349		
Viewing Angle	Hor.	Θ _L	CR ≥10 (at center point)	60	-	-	Degrees	(1), (5) BM-5A
		Θ _R		60	-	-		
	Ver.	Φ _H		45	-	-		
		Φ _L		45	-	-		
13 Points White Variation		δ			-	2.0		(6)

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Note 1) Definition of Viewing Angle :

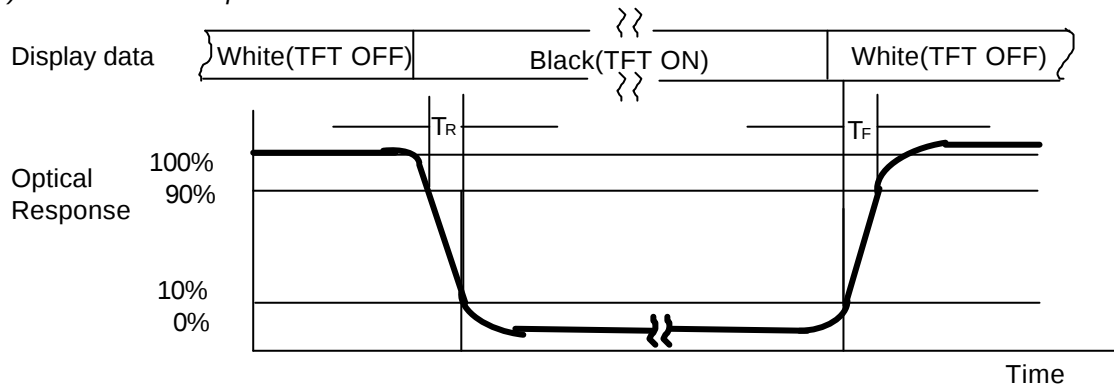


Note 2) Definition of Contrast Ratio (CR) :

$$CR = \frac{CR1 + CR2 + CR3 + CR4 + CR5}{5}$$

POINTS : (4) , (5) , (7) , (9) , (10) at FIGURE OF NOTE 6)

Note 3) Definition of Response time :



Note 4) Definition of Average Luminance of White : measure the luminance of white at 5 points.

Average Luminance of White ($Y_{L,AVE}$)

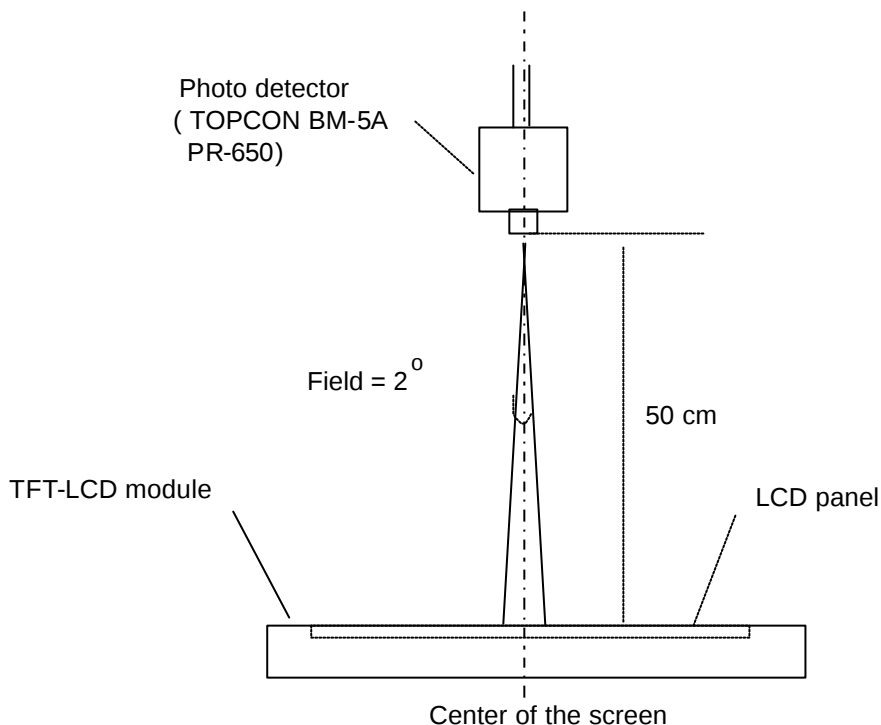
$$Y_{L,AVE} = \frac{Y_{L4} + Y_{L5} + Y_{L7} + Y_{L9} + Y_{L10}}{5}$$

POINTS : (4) , (5) , (7) , (9) , (10) at FIGURE OF NOTE 6)

Note 5) After stabilizing and leaving the panel alone at a given temperature for 30 minutes, the measurement should be executed. Measurement should be executed in a stable, windless, and dark room. 30 minutes after lighting the back-light. This should be measured in the center of screen.

Lamp current : 6.0 mA

Environment condition : $T_a = 25 \pm 2$

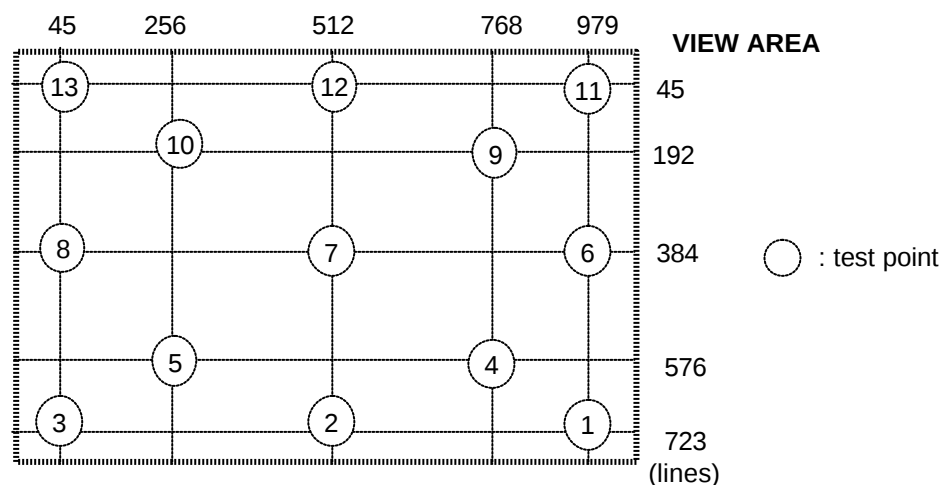


Optical characteristics measurement setup

Note 6) Definition of 13 points white variation (γ_w), CR variation (C_{VER}) [① ~ ⑬]

$$\delta_L = \frac{\text{Maximum luminance of 13 points}}{\text{Minimum luminance of 13 points}}$$

$$\delta C_R = \frac{\text{Maximum CR of 13 points}}{\text{Minimum CR of 13 points}}$$



3. ELECTRICAL CHARACTERISTICS

3.1 TFT LCD MODULE

Ta = 25 ± 2

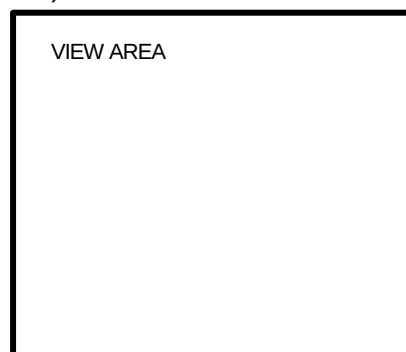
ITEM		SYMBOL	MIN	TYP	MAX	UNIT	NOTE
Voltage of Power Supply		V _{DD}	3.0	3.3	3.6	V	
Differential Input Voltage for LVDS Receiver Threshold	High	V _{IH}	-	-	+100	mV	V _{CM} =+1.2V
	Low	V _{IL}	-100	-	-	mV	
Vsync Frequency		f _v	-	60	-	Hz	
Hsync Frequency		f _H	-	63.98	-	KHz	
Main Frequency		f _{DCLK}	42.7	54	85	MHz	
Rush Current		I _{RUSH}	-	-	1.5	A	(4)
Current of Power Supply	White	I _{DD}	-	430	-	mA	(2),(3)*a
	Mosaic		-	450	-	mA	(2),(3)*b
	Max Pattern		-	550	600	mA	(2),(3)*c

Note (1) Display data pins and timing signal pins should be connected.(GND=0V)

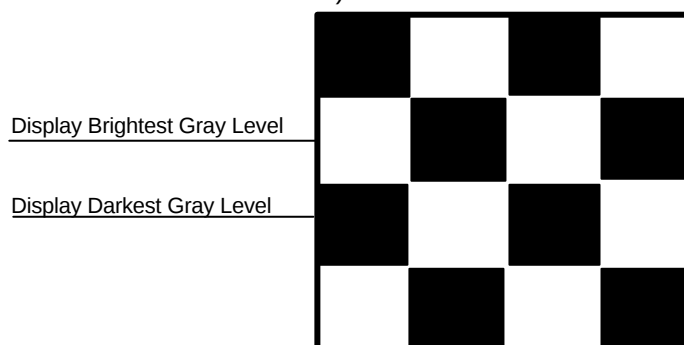
(2) f_v=60Hz, f_{DCLK} =54MHZ, V_{dd} = 3.3V , DC Current.

(3) Power dissipation pattern

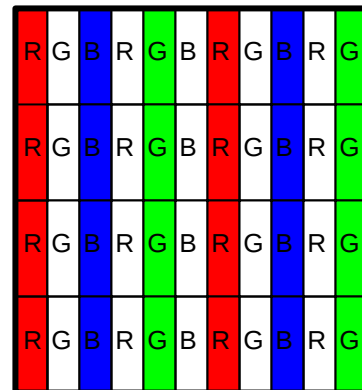
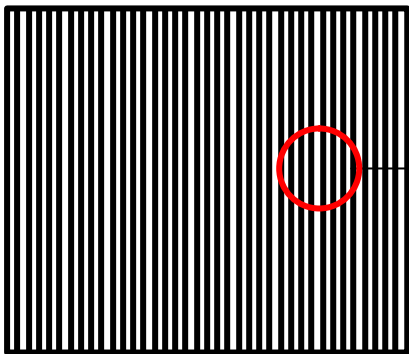
*a) White Pattern



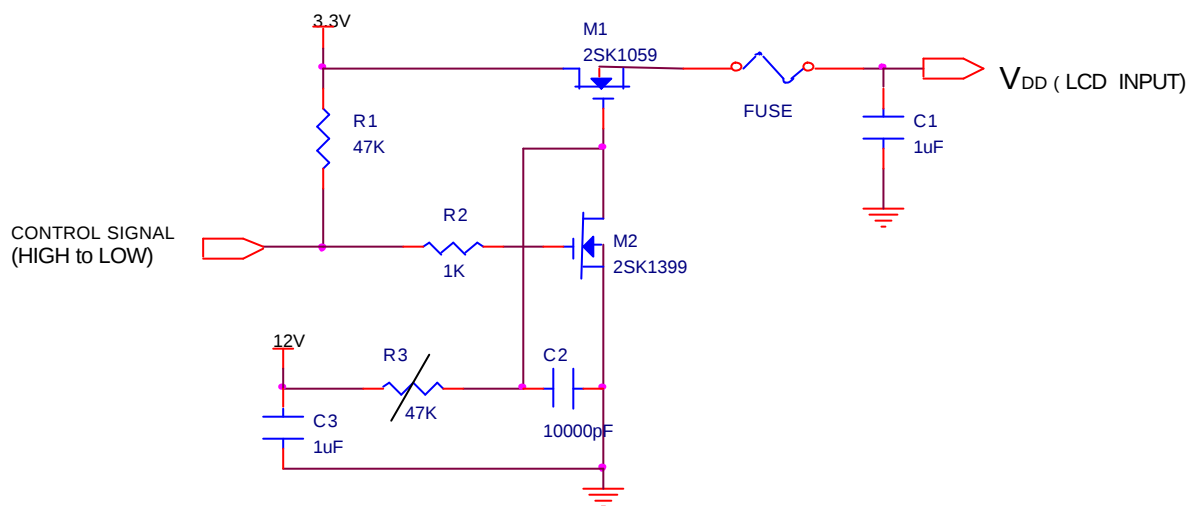
*b) Mosaic Pattern



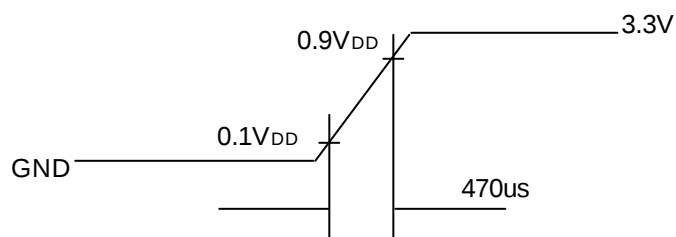
*c) Maximum Power pattern : 1dot vertical stripe



4) Rush current measurement condition



V_{DD} rising time is 470us



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3.2 BACK-LIGHT UNIT

The backlight system is an edge - lighting type with a single CCFT (Cold Cathode Fluorescent Tube).
The characteristics of a single lamp are shown in the following tables.

INVERTER : Ambit / Sumida

$T_a = 25 \pm 2$

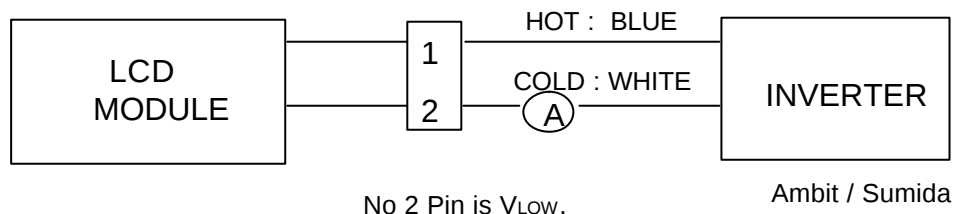
ITEM	SYMB	MIN	TYP	MAX	UNIT	NOTE
Lamp Current	I_L	2.0	6.0	7.0	mAms	(1)
Lamp Voltage	V_L		655		Vrms	$I_L=6.0mA$
Frequency	f_L	50	60	65	kHz	(2)
Power Consumption	P_L	-	3.93	-	W	(3)
Operating Life Time	Hr	10,000	-	-	Hour	(4)
Startup Voltage	V_s	-	-	1250	Vrms	25°C
				1450	Vrms	0 °C
Lamp Startup Time	V_s	-	-	1	sec	(5)

Note) The waveform of the inverter output voltage must be area symmetric and the design of the inverter must have specifications for the modularized lamp.

The performance of the backlight, for example life time or brightness, is much influenced by the characteristics of the DC-AC inverter for the lamp. So all the parameters of an inverter should be carefully designed so as not to produce too much leakage current from high-voltage output of the inverter.

When you design or order the inverter, please make sure that a poor lighting caused by the mismatch of the backlight and the inverter(miss lighting, flicker, etc.) never occur. When you confirm it, the module should be operated in the same condition as it is installed in your instrument.

Note (1) Lamp current is measured with a high frequency current meter as shown below.



(2) Lamp frequency may produce interference with horizontal synchronous frequency and this may cause line flow on the display. Therefore lamp frequency should be detached from the horizontal synchronous frequency and its harmonics as far as possible in order to avoid interference.

(3) refer to $I_L \times V_L$ to calculate.

(4) Life time (Hr) of a lamp can be defined as the time in which it continues to operate under the condition $T_a = 25 \pm 2$ and $I_L = 6.0$ mAms until one of the following event occurs.

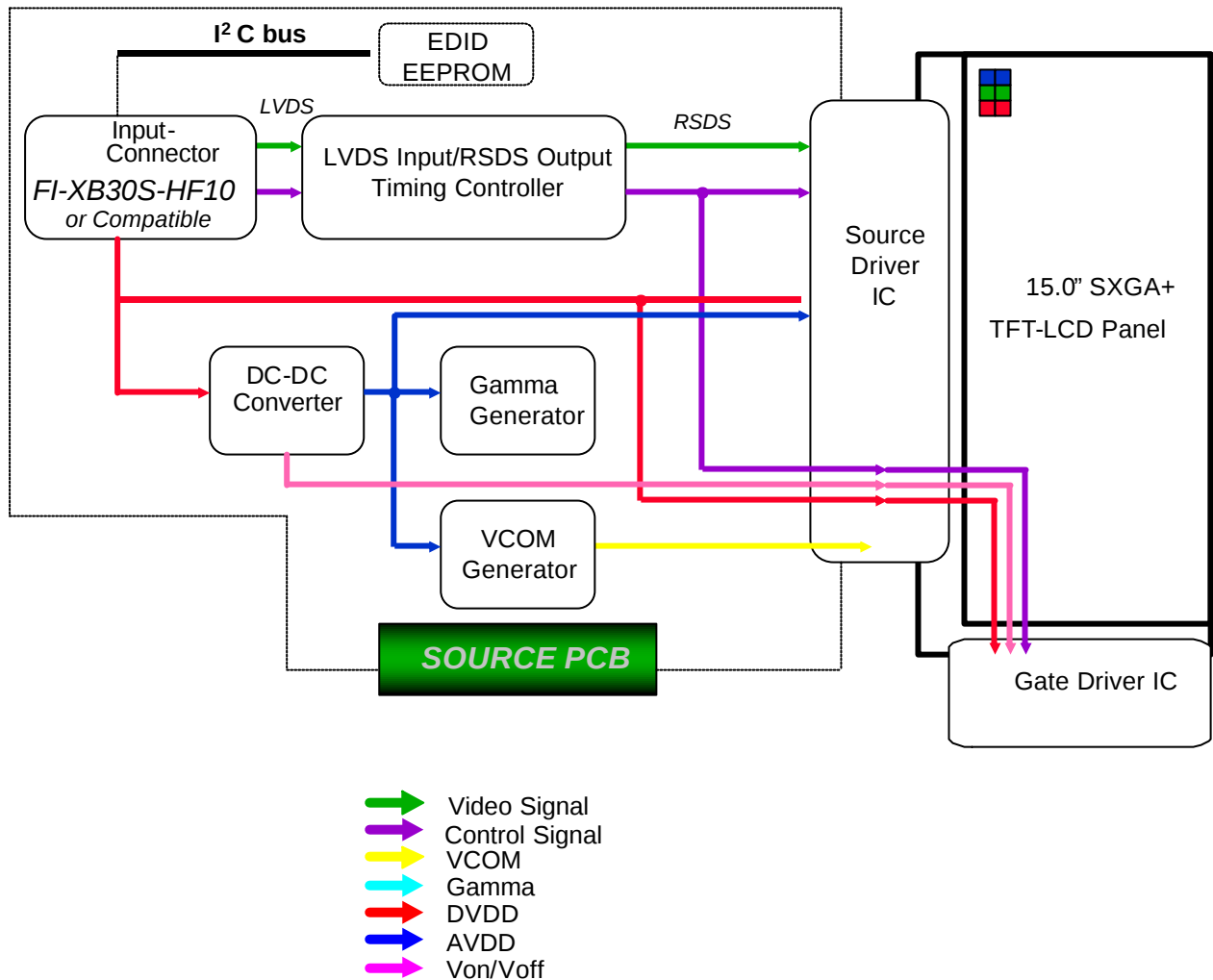
1. When the brightness becomes 50% or lower than the original.

(5) The voltage above this value should be applied to the lamp for more than 1 second to startup. Otherwise the lamp may not be turned on.

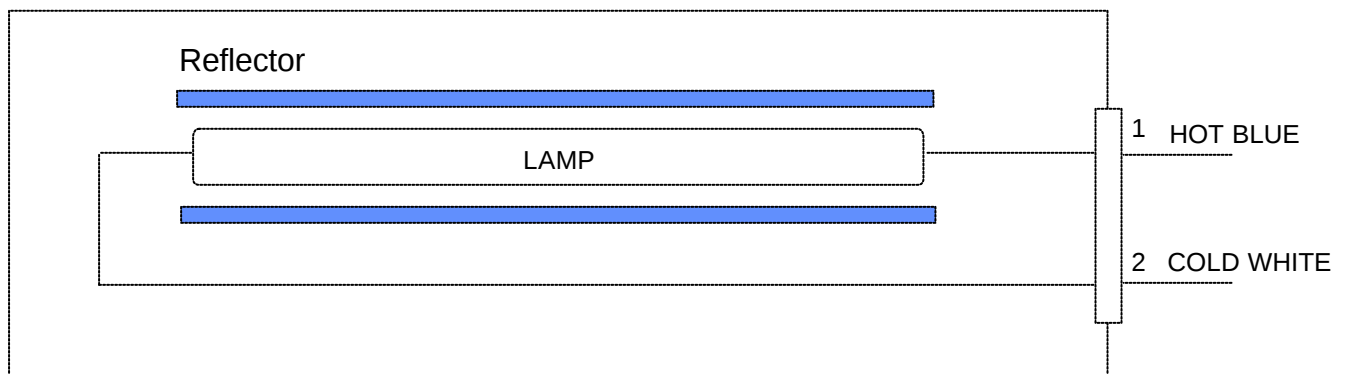
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4. BLOCK DIAGRAM

4.1 TFT LCD Module



4.2 BACKLIGHT UNIT



Note) The output of the inverter may change according to the material of the reflector.

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5. INPUT TERMINAL PIN ASSIGNMENT

5.1. Input Signal & Power LVDS, Connector : (JAE, FI-XB30SRL-HF11)

PIN NO	SYMBOL	FUNCTION	POLARITY	REMARK
1	Vss	Ground		
2	VDD	POWER SUPPLY +3.3V		
3	VDD	POWER SUPPLY +3.3V		
4	VEEDID	N/A (DDC 3.3V Power)		
5	BIST	Panel BIST control		
6	CLKEDID	N/A (DDC Clock)		
7	DATAEDID	N/A (DDC data)		
8	O_RxIN0-	LVDS Differential Data INPUT (Odd R0-R5,G0)	Negative	
9	O_RxIN0+	LVDS Differential Data INPUT (Odd R0-R5,G0)	Positive	
10	Vss	Ground		
11	O_RxIN1-	LVDS Differential Data INPUT (Odd G1-G5,B0-B1)	Negative	
12	O_RxIN1+	LVDS Differential Data INPUT (Odd G1-G5,B0-B1)	Positive	
13	Vss	Ground		
14	O_RxIN2-	LVDS Differential Data INPUT (Odd B1-B5,Sync,DE)	Negative	
15	O_RxIN2+	LVDS Differential Data INPUT (Odd B1-B5,Sync,DE)	Positive	
16	Vss	Ground		
17	O_RxCLK-	LVDS Differential Data INPUT (Odd Clock)	Negative	
18	O_RxCLK+	LVDS Differential Data INPUT (Odd Clock)	Positive	
19	Vss	Ground		
20	E_RxIN0-	LVDS Differential Data INPUT (Even R0-R5,G0)	Negative	
21	E_RxIN0+	LVDS Differential Data INPUT (Even R0-R5,G0)	Positive	
22	Vss	Ground		
23	E_RxIN1-	LVDS Differential Data INPUT (Even G1-G5,B0-B1)	Negative	
24	E_RxIN1+	LVDS Differential Data INPUT (Even G1-G5,B0-B1)	Positive	
25	Vss	Ground		
26	E_RxIN2-	LVDS Differential Data INPUT (Even B1-B5,Sync,DE)	Negative	
27	E_RxIN2+	LVDS Differential Data INPUT (Even B1-B5,Sync,DE)	Positive	
28	Vss	Ground		
29	E_RxCLK-	LVDS Differential Data INPUT (Even Clock)	Negative	
30	E_RxCLK+	LVDS Differential Data INPUT (Even Clock)	Positive	

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5.2 LVDS Interface : Transmitter DS90CF363 or Compatible

LVDS for Odd pixel

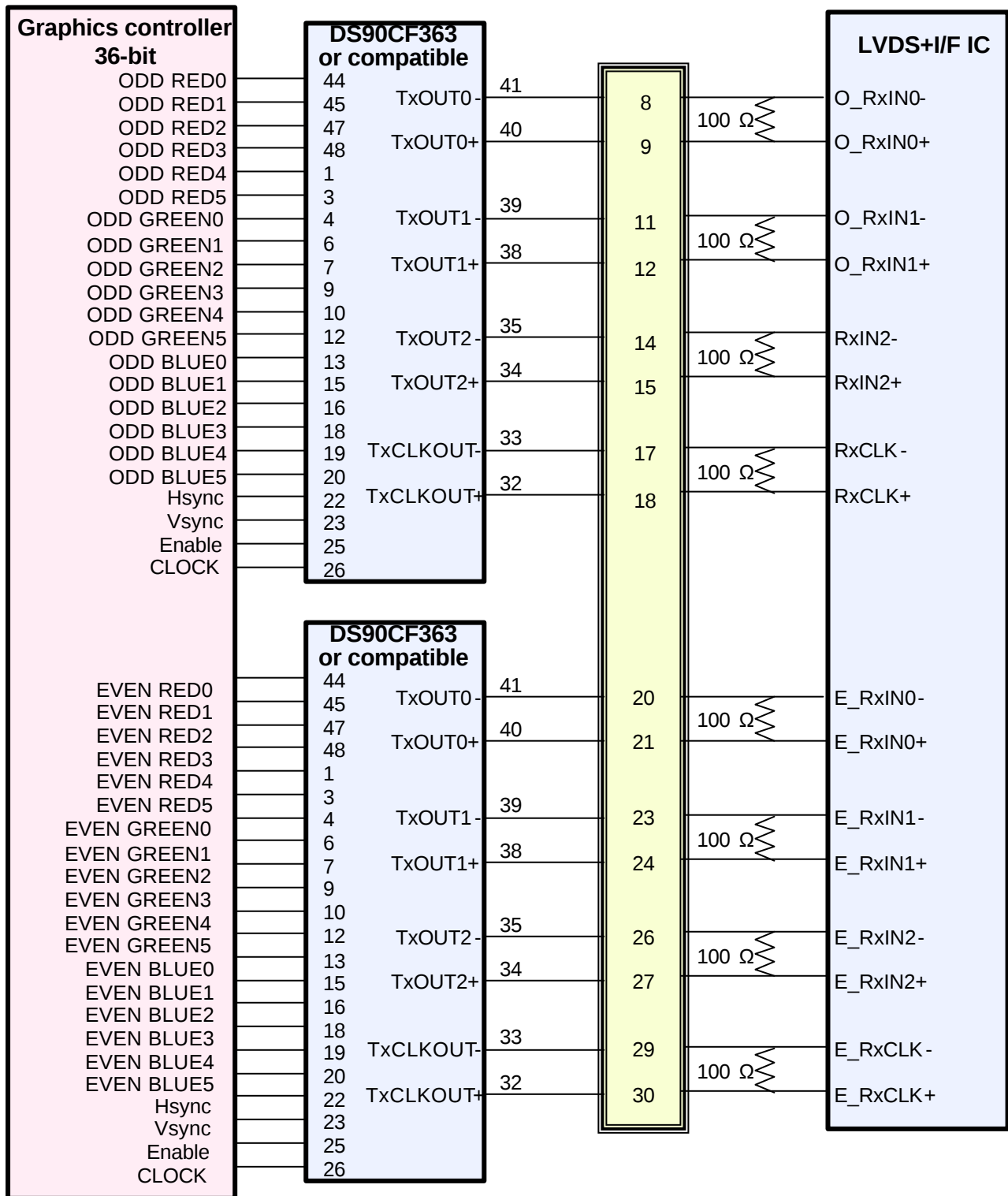
Pin No.	Name	RGB Signal	Pin No.	Name	RGB Signal
44	TxIN0	RO0	12	TxIN11	GO5
45	TxIN1	RO1	13	TxIN12	BO0
47	TxIN2	RO2	15	TxIN13	BO1
48	TxIN3	RO3	16	TxIN14	BO2
1	TxIN4	RO4	18	TxIN15	BO3
3	TxIN5	RO5	19	TxIN16	BO4
4	TxIN6	GO0	20	TxIN17	BO5
6	TxIN7	GO1	22	TxIN18	Hsync
7	TxIN8	GO2	23	TxIN19	Vsync
9	TxIN9	GO3	25	TxIN20	DE
10	TxIN10	GO4	26	TxCLK IN	Clock

LVDS for Even pixel

Pin No.	Name	RGB Signal	Pin No.	Name	RGB Signal
44	TxIN0	RE0	12	TxIN11	GE5
45	TxIN1	RE1	13	TxIN12	BE0
47	TxIN2	RE2	15	TxIN13	BE1
48	TxIN3	RE3	16	TxIN14	BE2
1	TxIN4	RE4	18	TxIN15	BE3
3	TxIN5	RE5	19	TxIN16	BE4
4	TxIN6	GE0	20	TxIN17	BE5
6	TxIN7	GE1	22	TxIN18	Hsync
7	TxIN8	GE2	23	TxIN19	Vsync
9	TxIN9	GE3	25	TxIN20	DE
10	TxIN10	GE4	26	TxCLK IN	Clock

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Flat Link Interface



Note : The LCD Module uses a 100ohm resistor between positive and negative lines of each receiver input.

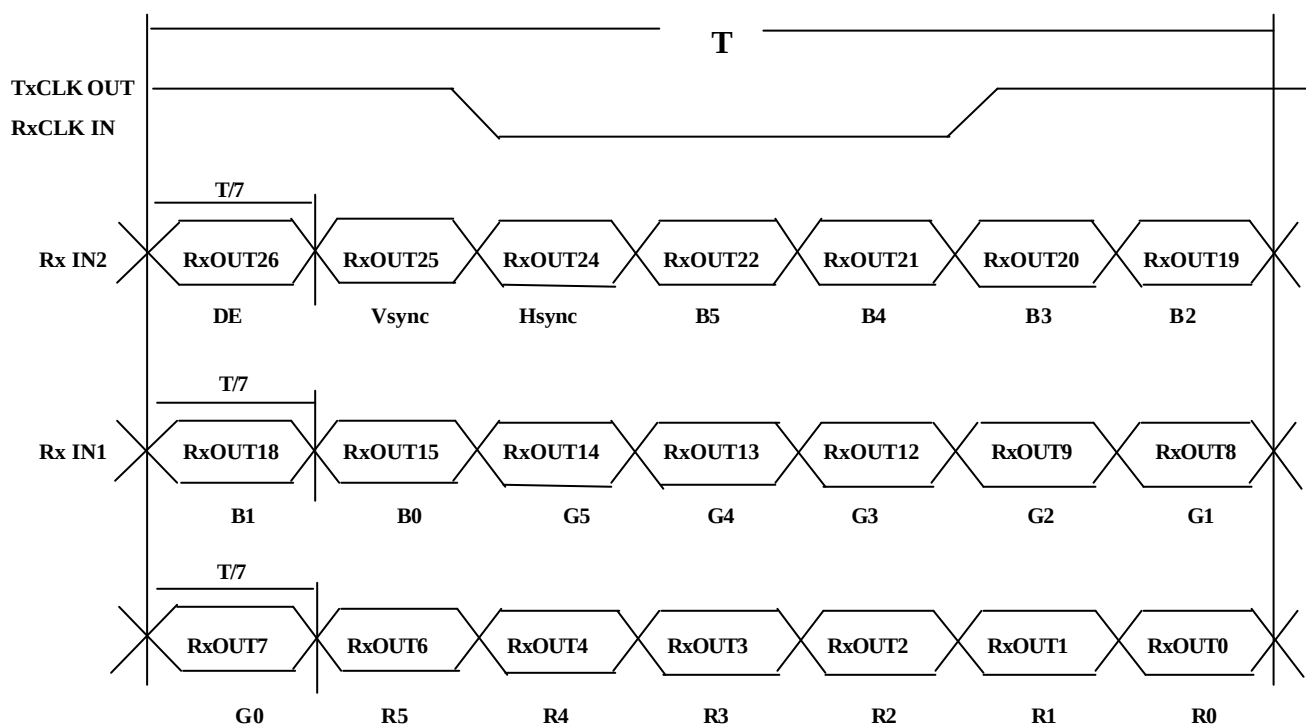
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5.3 BACK LIGHT UNIT

Connector : JST BHSR - 02VS -1

Pin NO.	Symbol	Color	Function
1	HOT	Blue	High Voltage
2	COLD	White	Ground

5.4 Timing Diagrams of LVDS For Transmission

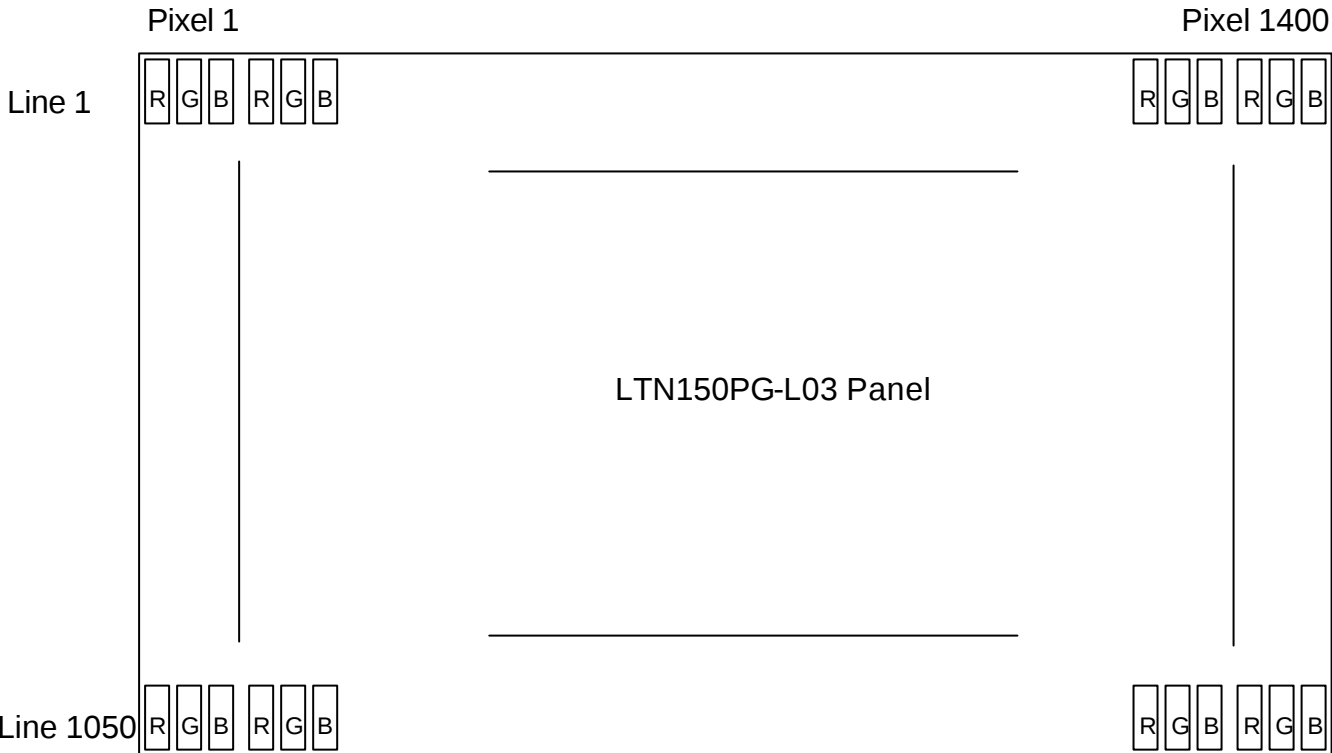


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5.6 Pixel Format in the display

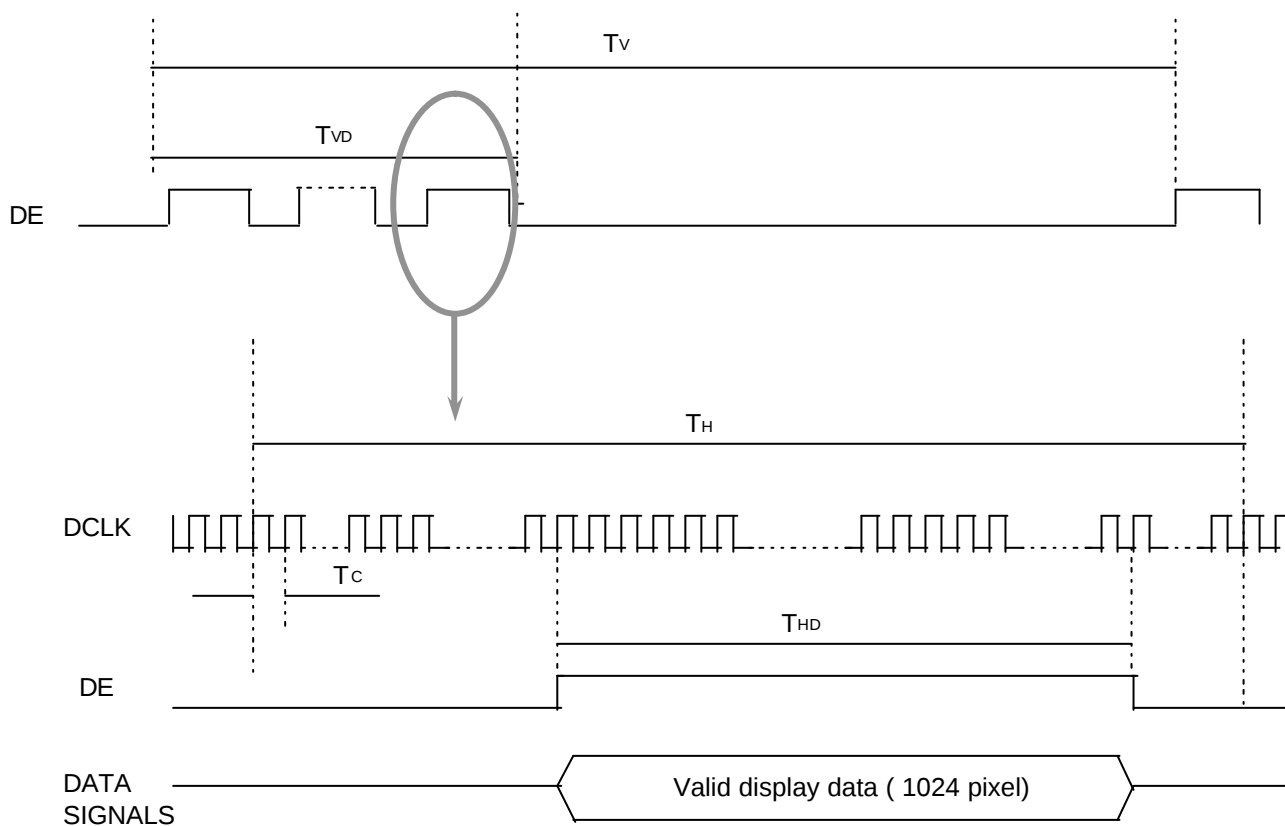


6. INTERFACE TIMING

6.1 Timing Parameters

Signal	Item	Symbol	MIN	TYP	MAX	Unit	Note
Frame Frequency	Cycle	T_v	-	1066	-	lines	
Vertical Active Display Term	Display Period	T_{VD}	-	1050	-	lines	
One Line Scanning Time	Cycle	T_H	-	844	-	clocks	(1)
Horizontal Active Display Term	Display Period	T_{HD}	-	700	-	clocks	

6.2 Timing diagrams of interface signal

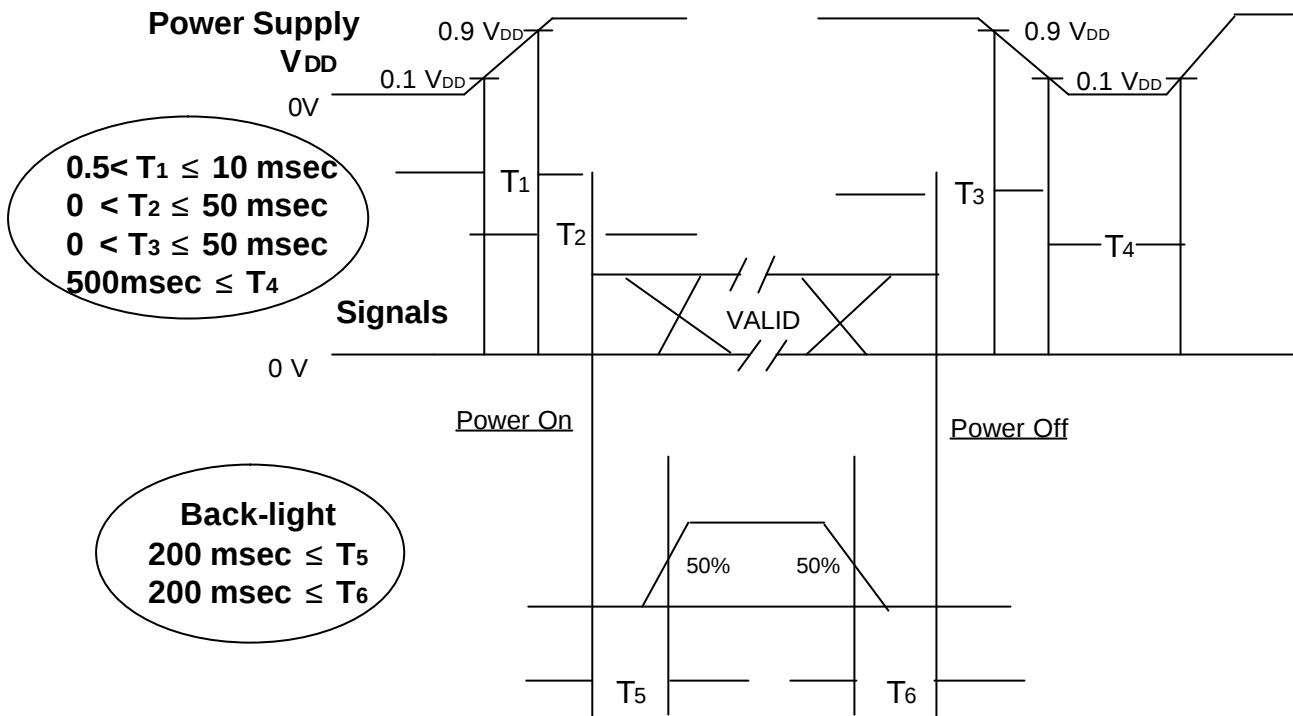


Note : All input condition(level&timing) for SN75LVDS88 are the same with those of LPD11826 or compatible.

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6.3 Power ON/OFF Sequence

: To prevent a latch-up or DC operation of the LCD module, the power on/off sequence shall be as shown below.



Power ON/OFF Sequence

- T1 : Vdd rising time from 10% to 90%
- T2 : The time from Vdd to valid data at power ON.
- T3 : The time from valid data off to Vdd off at power Off.
- T4 : Vdd off time for Windows restart
- T5 : The time from valid data to B/L enable at power ON.
- T6 : The time from valid data off to B/L disable at power Off.

NOTE.

- (1) The supply voltage of the external system for the module input should be the same as the definition of VDD.
- (2) Apply the lamp voltage within the LCD operation range. When the backlight turns on before the LCD operation or the LCD turns off before the backlight turns off, the display may momentarily become white.
- (3) In case of VDD = off level, please keep the level of input signals on the low or keep a high impedance.
- (4) T4 should be measured after the module has been fully discharged between power off and on period.
- (5) Interface signal shall not be kept at high impedance when the power is on.

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7. Mechanical Outline Dimension

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It will be attached with PDF file

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8. GENERAL PRECAUTIONS

1. Handling

- (a) When the module is assembled, It should be attached to the system firmly using every mounting holes. Be careful not to twist and bend the modules.
- (b) Refrain from strong mechanical shock and / or any force to the module. In addition to damage, this may cause improper operation or damage to the module and CCFT backlight.
- (c) Note that polarizers are very fragile and could be easily damaged. Do not press or scratch the surface harder than a HB pencil lead.
- (d) Wipe off water droplets or oil immediately. If you leave the droplets for a long time, Staining and discoloration may occur.
- (e) If the surface of the polarizer is dirty, clean it using some absorbent cotton or soft cloth.
- (f) The desirable cleaners are water, IPA(Isoprophyl Alcohol) or Hexane.
Do not use Keptone type materials(ex. Acetone), Ethyl alcohol, Toluene, Ethyl acid or Methyl chloride. It might permanent damage to the polarizer due to chemical reaction.
- (g) If the liquid crystal material leaks from the panel, it should be kept away from the eyes or mouth . In case of contact with hands, legs or clothes, it must be washed away thoroughly with soap.
- (h) Protect the module from static , it may cause damage to the C-MOS Gate Array IC.
- (i) Use fingerstalls with soft gloves in order to keep display clean during the incoming inspection and assembly process.
- (j) Do not disassemble the module.
- (k) Do not pull or fold the lamp wire.
- (l) Do not adjust the variable resistor which is located on the back side.
- (m) Protection film for polarizer on the module shall be slowly peeled off just before use so that the electrostatic charge can be minimized.
- (n) Pins of I/F connector shall not be touched directly with bare hands.

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2. STORAGE

- (a) Do not leave the module in high temperature, and high humidity for a long time.
It is highly recommended to store the module with temperature from 0 to 35°C and relative humidity of less than 70%.
- (b) Do not store the TFT-LCD module in direct sunlight.
- (c) The module shall be stored in a dark place. It is prohibited to apply sunlight or fluorescent light during the store.

3. OPERATION

- (a) Do not connect, disconnect the module in the “ Power On” condition.
- (b) Power supply should always be turned on/off by following item 6.3
“ Power on/off sequence “.
- (c) Module has high frequency circuits. Sufficient suppression to the electromagnetic interference shall be done by system manufacturers. Grounding and shielding methods may be important to minimize the interference.
- (d) The cable between the backlight connector and its inverter power supply shall be a minimized length and be connected directly . The longer cable between the backlight and the inverter may cause lower luminance of lamp(CCFT) and may require higher startup voltage (Vs).
- (e) The standard limited warranty is only applicable when the module is used for general notebook applications. If used for purposes other than as specified, SEC is not to be held reliable for the defective operations. It is strongly recommended to contact SEC to find out fitness for a particular purpose.

4. OTHERS

- (a) Ultra-violet ray filter is necessary for outdoor operation.
- (b) Avoid condensation of water. It may result in improper operation or disconnection of electrode.
- (c) Do not exceed the absolute maximum rating value. (the supply voltage variation, input voltage variation, variation in part contents and environmental temperature, so on)
Otherwise the module may be damaged.
- (d) If the module displays the same pattern continuously for a long period of time, it can be the situation when the image “sticks” to the screen.
- (e) This module has its circuitry PCB's on the rear side and should be handled carefully in order not to be stressed.

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